PART VII Fluid and Electrolyte Disorders

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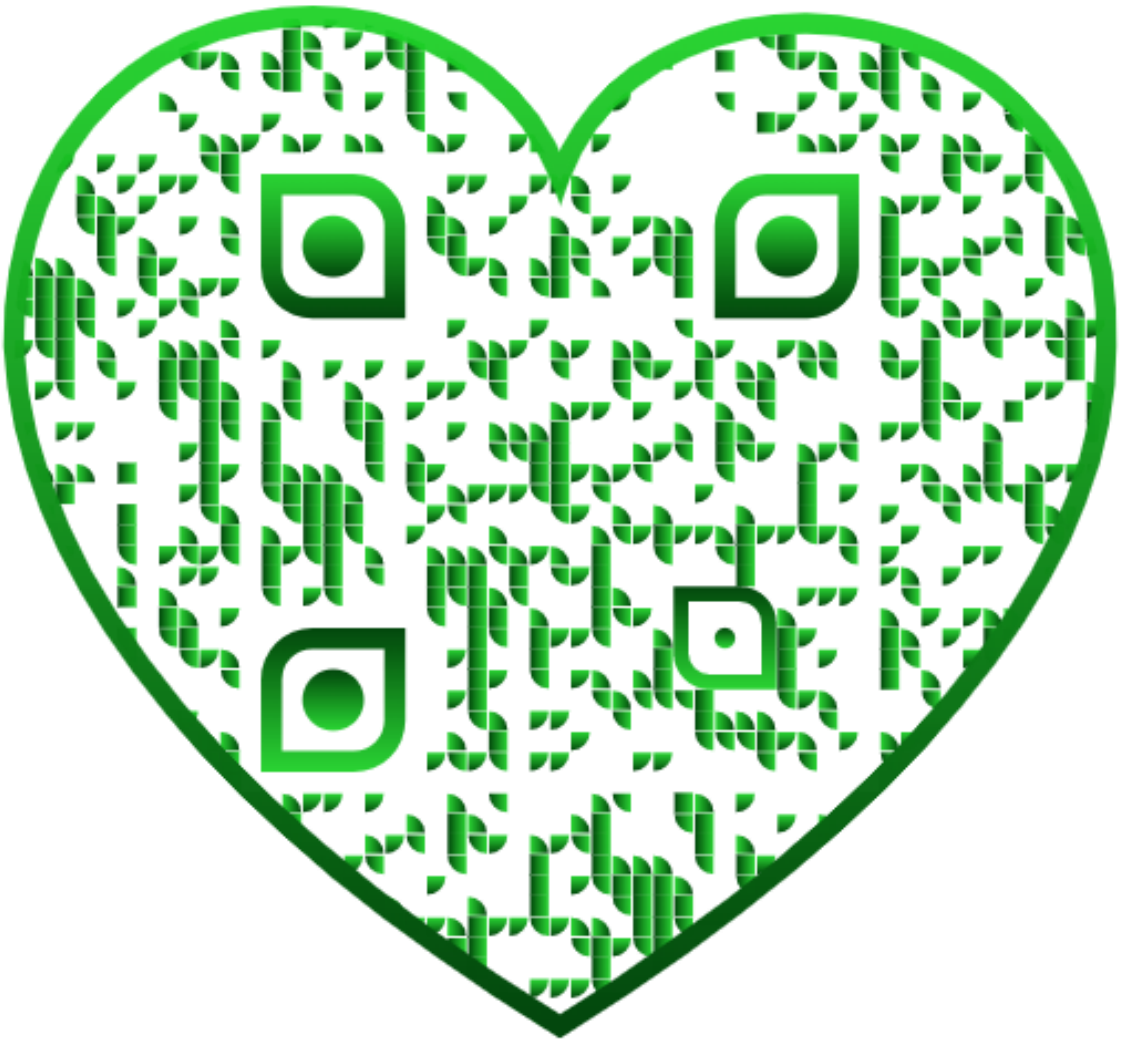
1. The ratio of the intracellular fluid volume to the extracellular fluid volume approaches adult levels at the age of
   A. 1 yr
   B. 2 yr
   C. 3 yr
   D. 4 yr
   E. 5 yr

2. Expansion of the intravascular volume and increased intravascular pressure are the main causes of edema in
   A. lymphatic obstruction
   B. heart failure
   C. protein-losing enteropathy
   D. nephrotic syndrome
   E. sepsis

3. The critical site for the renal regulation of sodium balance is the
   A. nephron
   B. proximal tubule
   C. loop of Henle
   D. distal tubule
   E. collecting duct

4. More than 40% of total body sodium is in the
   A. intravascular spaces
   B. interstitial spaces
   C. intracellular fluid
   D. bone
   E. gastrointestinal fluid

5. The **MOST** devastating consequence of untreated hypernatremia is
   A. brain hemorrhage
   B. seizures
   C. central pontinemyelinolysis
   D. extra pontinemyelinolysis
   E. brain edema



6. In a child with hypernatremic dehydration, the first priority is restoration of intravascular volume by

A. 3% saline
B. normal saline
C. lactated Ringer solution
D. 1/3 glucose saline
E. 1/2 glucose saline

7. Pseudohyponatremia is present in all the following **EXCEPT**

A. multiple myeloma
B. immunoglobulin infusion
C. protein losing enteropathy
D. hypertriglyceridemia
E. hypercholesterolemia

8. Hypervolemic hyponatremia is caused by

A. cirrhosis
B. cerebral salt wasting
C. pseudohypoaldosteronism type I
D. obstructive uropathy
E. bowel obstruction

9. Asymptomatic hyponatremia is seen in

A. cirrhosis
B. tap water enema
C. child abuse
D. hyperglycemia
E. tubule -interstitial nephritis

10. Syndrome of inappropriate antidiuretic hormone secretion (SIADH) is characterized by

A. extravascular volume expansion
B. high serum uric acid
C. high blood urea nitrogen
D. euvolemic hyponatremia
E. urine sodium <30 mEq/L

11. Spurious hyperkalemia or pseudohyperkalemia in children is usually exaggerated by

A. blood transfusions
B. digitalis intoxication
C. thrombocytosis
D. renal failure

E. malignant hyperthermia

12. The **MOST** common cause of hypokalemia in children is
    A. alkalemia
    B. distal rental tubular acidosis
    C. gastroenteritis
    D. diabetic ketoacidosis
    E. loop diuretic

13. Spurious hypokalemia occurs in patients with
    A. laxative abuse
    B. high white blood cell count
    C. hypomagnesaemia
    D. posthypercapnia
    E. Cushing syndrome

14. The mechanism of hypokalemia in emesis is mainly due to
    A. gastric loss of potassium
    B. gastric loss of hydrochloric acid
    C. low aldosterone level
    D. dehydration
    E. hypomagnesaemia

15. Renal manifestations of hypokalemia include all the following **EXCEPT**
    A. polyuria
    B. urinary retention
    C. decrease ammonia production
    D. interstitial nephritis
    E. renal cysts

16. Medications that cause renal losses of magnesium include all the following **EXCEPT**
    A. amphotericin
    B. cisplatin
    C. lithium
    D. proton pump inhibitors
    E. mannitol

17. ECG changes in hypomagnesaemia is characterized by
    A. peaking of the T waves and ST-segment depression
    B. flattened T wave and depressed ST segment
    C. flattening of the T wave and lengthening of the ST segment
    D. prolonged PR, QRS, and QT intervals

E. appearance of a U wave

18. Clinical manifestations of hypermagnesemia include all the following **EXCEPT**
A. hypotonia
B. hyporeflexia
C. sleepiness
D. hypertension
E. vomiting

19. Treatment of hypermagnesmia include all the following **EXCEPT**
A. intravenous hydration
B. loop diuretics
C. Kayexalate
D. exchange transfusion
E. intravenous calcium gluconate

20. The **MOST** common cause of hyperphosphatemia is
A. acute hemolysis
B. vitamin D intoxication
C. renal insufficiency
D. cow's milk intake
E. hypoparathyroidism

21. Systemic calcification occurs when plasma calcium × plasma phosphorus, both measured in mg/dL is
A. >90
B. >80
C. >70
D. >60
E. >50

22. All the following phosphorus binders are used in chronic renal insufficiency **EXCEPT**
A. calcium carbonate
B. calcium acetate
C. sevelamer
D. lanthanum
E. aluminum

23. Normal anion gap metabolic acidosis can occur in
A. renal failure
B. liver failure
C. severe anemia

D. malignancy
E. starvation ketoacidosis

24. The time for the kidneys to complete appropriate metabolic compensation for a primary respiratory process is
A. 12-24 hr
B. 24-36 hr
C. 36-48 hr
D. 48-72 hr
E. 72-96 hr

25. Metabolic acidosis with increased anion gap occurs in
A. ammonium chloride intake
B. posthypocapnia
C. urinary tract diversions
D. hyporeninemic hypoaldosteronism
E. severe anemia

26. Metabolic alkalosis with urinary chloride >20 meq/l occurs in
A. loop diuretics
B. cystic fibrosis
C. Cushing syndrome
D. emesis
E. post-hypercapnia

27. In metabolic alkalosis secondary to gastric loss, all the following mechanisms prevent renal bicarbonate loss **EXCEPT**
A. mineralocorticoid escape phenomenon
B. reduce GFR
C. sodium and bicarbonate resorption
D. increase aldosterone level
E. hypokalemia

28. Contraction alkalosis occurs in
A. metformin
B. diuretic use
C. propofol
D. methanol
E. toluene

29. Measuring serum concentrations of renin and aldosterone differentiates children with metabolic alkalosis; both renin and aldosterone are elevated in

A. renovascular disease
B. glucocorticoid-remediable aldosteronism
C. Liddle syndrome
D. Cushing syndrome
E. 11β-hydroxylase deficiency

30. Increased production of CO_2 occurs in all the following **EXCEPT**
A. fever
B. emesis
C. excess caloric intake
D. high levels of physical activity
E. increased respiratory muscle work

31. CNS manifestations of respiratory alkalosis include
A. psychosis
B. anxiety
C. asterixis
D. paresthesia
E. hallucinations

32. Respiratory acidosis occurs in
A. severe anemia
B. carbon monoxide poisoning
C. hypophosphatemia
D. hypotension
E. Liddle syndrome

33. The **MOST** important indication of mechanical ventilation in respiratory acidosis is
A. Pco_2>75 mm Hg
B. concomitant metabolic acidosis
C. slowly responsive underlying disease
D. hypoxia that responds poorly to oxygen
E. tiring patient

34. Very-low birth weight infants can have insensible losses of
A. 10-20 mL/kg/24 hr.
B. 30-40 mL/kg/24 hr.
C. 50-60 mL/kg/24 hr.
D. 70-80 mL/kg/24 hr.
E. 100-200 mL/kg/24 hr.

35. For each 1°C increase in temperature above 38°C leads to increase in maintenance water needs by

A. 5-10%
B. 10-15%
C. 15-20%
D. 20-25%
E. 25-30%

36. The best fluid bolus giving to a child with isolated vomiting and severe dehydration is

A. normal saline
B. ringer lactate
C. half-normal saline
D. hypertonic (3%) saline
E. 5% dextrose + half-normal saline

37. The **MOST** common manifestation of cerebral edema from an overly rapid decrease of serum sodium concentration during correction of hypernatremic dehydration is

A. irritability
B. hyperreflexia
C. spastisity
D. seizure
E. coma

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ANSWERS
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1.**(A).**
2.**(B).** There is an increase in venous hydrostatic pressure from expansion of the intravascular volume, which is caused by impaired pumping by the heart, and the increase in venous pressure causes fluid to move from the intravascular space to the interstitial space.
3.**(E).** Even though the amount of sodium resorbed in this segment is less than in any other segment.
4.**(D).**
5.**(A).** As the extracellular osmolality increases, water moves out of brain cells, leading to a decrease in brain volume, this decrease can result in tearing of intra cerebral veins and bridging blood vessels as the brain moves away from the skull and the meninges, patients may have subarachnoid, subdural, and parenchymal hemorrhages. Seizures and brain edema are more common during correction of hypernatremia.
6.**(B).** Repeated boluses of normal saline (10-20 mL/kg) may be required to treat hypotension, tachycardia, and signs of poor perfusion (poor peripheral pulses and capillary refill time).
7.**(C).** Hypoalbuminemia caused by gastrointestinal disease (protein losing enteropathy) cause hypervolemichyponatremia, while pseudohyponatremia is a laboratory artifact that is present when the plasma contains very high concentrations of protein (multiple myeloma, intravenous immunoglobulin infusion) or lipid.
8.**(A).** Other distracters are causes of hypovolemic hyponatremia.
9.**(D).** Because the manifestations of hyponatremia are a result of the low plasma osmolality, patients with hyponatremia resulting from hyperosmolality do not have symptoms of hyponatremia.
10.**(D).** Because SIADH is a state of intravascular volume expansion, low serum uric acid and BUN levels are supportive of the diagnosis, the kidney increases sodium excretion in an effort to decrease intravascular volume to normal; thus, the patient has a mild decrease in body sodium(urine sodium >30 mEq/L).
11.**(C).** This phenomenon is exaggerated with thrombocytosis because of potassium release from platelets, for every 100,000/m3 increase in the platelet count; the serum potassium level rises by approximately 0.15 mEq/L.
12.**(C).**
13.**(B).** Spurious hypokalemia occurs in patients with leukemia and very elevated white blood cell counts if sample for analysis is left at room temperature, permitting the white blood cells to take up potassium from the plasma.

14.**(B).** The gastric loss of hydrochloric acid (HCl), leading to a metabolic alkalosis and a state of volume depletion. The kidney compensates for the metabolic alkalosis by excreting bicarbonate in the urine, but there is obligate loss of potassium and sodium with the bicarbonate. The volume depletion raises aldosterone levels, further increasing urinary potassium losses and preventing correction of the metabolic alkalosis and hypokalemia until the volume depletion is corrected.
15.**(C).** Hypokalemia stimulates renal ammonia production, an effect that is clinically significant if hepatic failure is present, because the liver cannot metabolize the ammonia. Hypokalemia impairs bladder function, potentially leading to urinary retention.
16.**(C).** Mild hypermagnesemia may occur in lithium ingestion.
17.**(C).** ECG changes in hyperkalemia include peaking of the T waves, this is followed, as the potassium level increases, by ST-segment depression, an increased PR interval, flattening of the P wave, and widening of the QRS complex. In hypokalemia a flattened T wave, a depressed ST segment, and the appearance of a U wave. In hypermagnesemia ECG changes include prolonged PR, QRS, and QT intervals.
18.**(D).** Elevated magnesium values are associated with hypotension because of vascular dilatation, which also causes flushing.Hypotension can be profound at higher concentrations from a direct effect on cardiac function.
19.**(C).** Kayexalate used for treatment of hypokalemia.
20.**(C).**
21.**(C).**
22.**(E).** Because of the risk of toxicity.
23.**(A).** In renal failure, there is retention of unmeasured anions, including phosphate, urate, and sulfate. The increase in unmeasured anions in renal failure is usually less than the decrease in the bicarbonate concentration. Renal failure is thus a mix of an increased gap and a normal gap metabolic acidosis. The normal gap metabolic acidosis is especially prominent in children with renal failure as a result of tubular damage, as occurs with renal dysplasia or obstructive uropathy, because these patients have a concurrent RTA.Other distractors are causes of high anion gap metabolic acidosis.
24.**(E).** While the respiratory compensation for a metabolic process happens quickly and is complete within 12-24 hr.
25.**(E).** Because of tissue hypoxia.
26.**(C).** Other distracters are causes of metabolic alkalosis and urinary chloride less than 15 meq/L.
27.**(A).**
28.**(B).** Diuretic use causes fluid loss without bicarbonate; thus, the remaining body bicarbonate is contained in a smaller total body fluid compartment.
29.**(A).** Aldosterone is high and renin is low in patients with adrenal adenomas or hyperplasia and glucocorticoid-remediable aldosteronism. Renin and aldosterone are low in children with Cushing syndrome, Liddle syndrome, licorice ingestion, 17α-

hydroxylase deficiency, 11β-hydroxylase deficiency, and 11β-hydroxysteroid dehydrogenase deficiency.

30.**(B).**

31.**(D).** The paresthesia, tetany, and seizures may be partially related to the reduction in ionized calcium that occurs because alkalemia causes more calcium to bind to albumin.

32.**(C).** Hypophosphatemia cause respiratory muscle weakness.

33.**(A).**

34.**(E).**

35.**(B).**

36.**(A).** Ringer lactate should not be used because the lactate would worsen the alkalosis.

37.**(D).**